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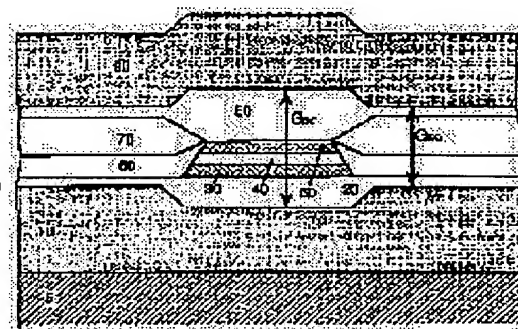
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(54) MAGNETO-RESISTANCE EFFECT TYPE REPRODUCING HEAD AND MAGNETIC RECORDING AND REPRODUCING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce a blot on reproducing sensitivity in weakening a magnetic field from a medium to be worked upon both sides of magnetism sensitive parts by making a space of a magnetic shield film between positions of electrode parts provided on both end parts of a magneto-resistance effect film in the longitudinal direction narrower than or the same as a space of a magnetic shield film between the magnetism sensitive parts.

SOLUTION: The lower shield film 10 is formed on a substrate 5 and laminated with an organic resist film, and is then patterned with a prescribed shape in an area equivalent to a track width and is laminated with a lower magnetic gap forming insulation film 20, a soft magnetic film 30, a nonmagnetic electroconductive film 40 and a magneto-resistance effect film 50. Subsequently, after laminating an organic resist film, patterning it into a desired shape is performed. Then, a permanent magnet film 60 is laminated and processed to be a desired shape, and is then Nb/Au/Nb are laminated and processed to make an electrode 70. Subsequently, after laminating an upper magnetic gap forming insulation film 80, the insulation film 80 in its area equivalent to the track width is removed to form a prescribed step. In this MR head, the space of the magnetic shield film between the electrode part positions is narrower than that between the magnetism sensitive part positions by 0.1 μm .



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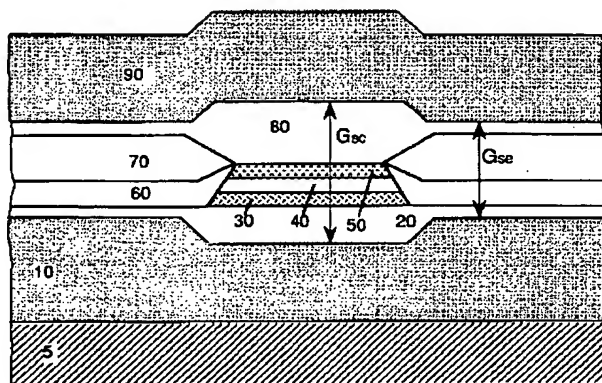
(54) 【発明の名称】 磁気抵抗効果型再生ヘッドならびに磁気記録再生装置

(57) 【要約】

【課題】 クロストーク量が小さく、しかも、安定に動作する磁気抵抗効果型再生ヘッドを提供する。

【解決手段】 電極部位置における磁気シールド膜の間隔を、感磁部位置における磁気シールド膜の間隔と同じかもしくは狭くする。

図 1



【特許請求の範囲】

【請求項 1】磁気抵抗効果膜と、前記磁気抵抗効果膜に電流を流すための一対の電極と、前記磁気抵抗効果膜に横バイアス磁界を印加するための手段と、前記磁気抵抗効果膜に縦バイアス磁界を印加するための手段とを含む磁気抵抗効果素子が、積層方向に離間して設けられた一対の磁気シールド膜の間に配置されている磁気抵抗効果型ヘッドにおいて、前記電極部位置における磁気シールド膜の間隔が、感磁部位置における磁気シールド膜の間隔より狭い、もしくは同じであることを特徴とする磁気抵抗効果型再生ヘッド。

【請求項 2】少なくとも 2 層の磁性層及びそれらを分離する非磁性層からなる磁気抵抗効果膜および上記磁気抵抗効果膜に電流を供給する一対の電極を有し、上記 2 つの磁性層の磁化の向きの差によって抵抗変化を得る磁気抵抗効果素子が、積層方向に離間して設けられた一対の磁気シールド膜の間に配置されている磁気抵抗効果型ヘッドにおいて、前記電極部位置における磁気シールド膜の間隔が、感磁部位置における磁気シールド膜の間隔より狭い、もしくは同じであることを特徴とする磁気抵抗効果型再生ヘッド。

【請求項 3】上記電極部位置における磁気シールド膜の間隔 G_{se} と感磁部位置における磁気シールド膜の間隔 G_{sc} の比 G_{se}/G_{sc} が、0.6 から 1 であることを特徴とする請求項 1 又は 2 の磁気抵抗効果型再生ヘッド。

【請求項 4】基板上に積層して設けられた横バイアス磁界印加用の軟磁性膜、非磁性導電膜及び磁気抵抗効果膜、前記磁気抵抗効果膜の長手方向両端部に設けられた縦バイアス磁界印加用の一対の永久磁石膜、並びに前記一対の永久磁石膜上に設けられた一対の電極とを備えることを特徴とする請求項 1 の磁気抵抗効果型再生ヘッド。

【請求項 5】少なくとも 2 層の磁性層及びそれらを分離する非磁性層からなる磁気抵抗効果膜のうち少なくとも 1 層に接して反強磁性膜を設け、この反強磁性膜との磁気的な交換結合によって、上記磁性層の磁化に一方異方性が印加されており、さらに、前記磁気抵抗効果膜の長手方向両端部に縦バイアス磁界印加用の一対の永久磁石膜を備えることを特徴とする請求項 2 の磁気抵抗効果型再生ヘッド。

【請求項 6】一対の磁極、該一対の磁極を磁気的に結合する磁気回路手段および前記磁気回路に鎖交するコイルを含む磁気記録用誘導型薄膜ヘッドと、前記請求項 1 ～ 5 のいずれか一項に記載の磁気抵抗効果型再生ヘッドとを備えることを特徴とする記録再生分離型磁気ヘッド。

【請求項 7】磁気記録媒体と、請求項 1 ～ 6 のいずれか一項に記載のヘッドと前記磁気記録媒体と前記ヘッドとを相対的に駆動する駆動手段と、前記ヘッドに接続された記録再生信号処理計とを含むことを特徴とする磁気記録再生装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、磁気記録媒体から情報信号を読み取るための再生ヘッドに係り、特に改良された磁気抵抗効果型再生ヘッドならびにそれを用いた磁気記録再生装置に関するものである。

【0002】

【従来の技術】磁気記録の高密度化に伴い、再生用磁気ヘッドに高い感度が求められている。高感度の再生磁気ヘッドとして、磁気抵抗効果型ヘッド（MRヘッド）と呼ばれるものが知られている。磁気抵抗効果型ヘッドは、記録媒体からの磁界を、素子の抵抗変化として検出する。従来の一般的な磁気抵抗効果型ヘッドは、抵抗が磁化と電流方向との間の角度 θ の関数として $\cos 2\theta$ に比例して変化する成分を持つという、異方性磁気抵抗効果（AMR）に基づいて動作する。

【0003】一方、異方性磁気抵抗効果とは別の原理で動作する磁気抵抗効果型ヘッドとして、フィジカル レビュー(Physical Review) B, 第 4 3 巻, 1 2 9 7 ～ 1 3 0 0 頁「軟磁性多層膜における巨大磁気抵抗効果」に記載のように 2 層の磁性層を非磁性層で分離し、一方の磁性層に反強磁性層からの交換バイアス磁界を印加する構造のヘッドが知られている。このような多層膜においては、抵抗 R は、2 層の磁性層の磁化の間の角 θ に関数として、 $\cos \theta$ に比例して変化する成分を有することが、上記論文に示されており、このような効果を、巨大磁気抵抗効果(GMR)と呼んでいる。このような、多層膜の巨大磁気抵抗効果を利用した磁気抵抗効果型ヘッドは、異方性磁気抵抗効果を利用したヘッドと比べて、大きい磁気抵抗変化量 ΔR を示すことが知られている。

【0004】一般に、AMRヘッドおよびGMRヘッドでは、高透磁率の軟磁性材料からなるシールド膜を、媒体走行方向に対して、磁気抵抗効果膜の前後に配置した構造をとる。これは、磁気抵抗効果膜に流入する信号磁界を、磁気抵抗効果膜の端部にまで効率よく導き、磁気抵抗効果膜を均一に磁化させるためである。また同時に、隣接するビットからの漏れ磁界を遮断する。このような構造は線記録密度を高めて、再生出力を高める方法として有効であることが知られている。

【0005】図 7 に従来の MRヘッドの断面を示す。従来の MRヘッドでは、基板 5 上に均一な膜厚を有する磁気シールド層 1 0 および磁気ギャップ層 2 0 を形成し、その上にパターンニングされた磁気抵抗効果膜（3 0, 4 0, 5 0）と、その両端部に、磁気抵抗効果膜よりも膜厚が大きい電極膜 7 0 および永久磁石 6 0 が配置される。さらに、その上に、均一な膜厚の磁気ギャップ層 8 0 を介して磁気シールド膜 9 0 を形成するため、電極部位置における磁気シールド膜の間隔 G_{se} は、磁気抵抗効果膜（感磁部）位置における磁気シールド膜の間隔 G_{sc} より広い構造になっている。

【0006】

【発明が解決しようとする課題】この従来技術においては、トラック幅方向の感度分布の裾が長い、高いトラック密度での再生において、隣接トラックからのクロストークが大きいという問題があった。また、記録ヘッドからの強い磁界がMRヘッドに印加された場合、磁気抵抗効果膜の長手方向両端部に設けられた縦バイアス磁界印加用の永久磁石膜の磁化状態が変化して、MRヘッドの出力が不安定になるという問題があった。

【0007】本発明は安定に動作し、しかも、高トラック密度に適したMRヘッドを提供することを目的とするものである。

【0008】

【課題を解決するための手段】上記目的は、磁気抵抗効果膜の長手方向両端部に設けられた電極部位置における磁気シールド膜の間隔を、感磁部位置における磁気シールド膜の間隔より狭くするか、もしくは同じとすることにより達成される。

【0009】ここで、上記電極部位置における磁気シールド膜の間隔Gseと感磁部位置における磁気シールド膜の間隔Gscの比Gse/Gscが、0.6から1であることが好ましい。

【0010】また、本発明の磁気抵抗効果型再生ヘッドは、磁気記録用誘導型薄膜ヘッドと組み合わせて、記録再生分離型磁気ヘッドを構成することができる。

【0011】磁気シールド空間内部に流入する記録媒体からの磁界や記録ヘッドからの磁界は、磁気シールド膜の間隔が狭いほど、その強度が弱まる。上述のように、電極部位置における磁気シールド膜の間隔を、従来より狭くすると、感磁部の両側にかかる媒体からの磁界が弱まるため、再生感度のにじみを低減でき、隣接トラックからのクロストークを低減できる。

【0012】さらに、感磁部の長手方向両端部に設けられた永久磁石膜に印加される磁界も減少するため、媒体および記録ヘッドからの磁界による永久磁石膜の磁化状態の変化が低減でき、MRヘッドの出力安定性を向上することができる。

【0013】

【発明の実施の形態】以下、本発明の実施例について詳細に説明する。

【0014】（実施例1）本発明による代表的な磁気抵抗効果型ヘッドの断面図を図1に示す。基板5上に、厚さ2μmの下部シールド膜（NiFe膜）10を形成し、有機レジスト膜を積層した後、ほぼトラック幅に相当する領域で、約65nmの段差がつくようにパターニングを行った。次に、磁気ギャップ形成用絶縁膜（AlO膜）20を形成して、トラック幅に相当する領域における厚さが85nm、それ以外の領域における厚さが20nmとなるように加工した。さらに、厚さ20nmの軟磁性膜（NiFeNb膜）30、厚さ10nmの非磁

性導電膜（Ta膜）40、厚さ20nmの磁気抵抗効果膜（NiFe膜）50を積層した。

【0015】次に、有機レジスト膜を積層した後、所望の形状にパターニングを行った。さらに、厚さ30nmの永久磁石膜（CoCrPt膜）60を積層し、所望の形状に加工した後、Nb/Au/Nbを積層、加工し電極70とした。さらに、厚さ115nmの磁気ギャップ形成用絶縁膜（AlO膜）80を積層したのち、トラック幅に相当する領域で約35nmの段差がつくように、トラック幅の両側部分に相当する絶縁膜80を除去した。さらにその上に厚さ2μmの上部シールド膜（NiFe膜）90を積層し所望の形状に加工して磁気ヘッドとした。

【0016】本実施例におけるMRヘッドは、電極部位置における磁気シールド膜の間隔Gseが、感磁部位置における磁気シールド膜の間隔Gscより0.1μm狭く、Gse/Gscが、0.6の構造である。

【0017】図2は本実施例のヘッド（a）と、電極部位置における磁気シールド膜の間隔が感磁部位置における磁気シールド膜の間隔より80nm広い従来ヘッド（b）の、トラック幅方向の感度分布を示したものである。ヘッドのトラック幅より狭い領域に記録した媒体を、トラック幅方向に移動しながら再生出力を測定した。図からわかるように本発明のヘッド（a）は、従来ヘッド（b）に比べて、感度分布における裾のひろがりを低減することができた。実際、ヘッドが隣の媒体の端部と0.3μm重なったオフトラック時に再生を行った結果、ヘッド（a）のクロストーク量は（b）より約8dB減少した。

【0018】電極部位置における磁気シールド膜の間隔Gseと、感磁部位置における磁気シールド膜の間隔Gscの比、Gse/Gscが異なるMRヘッドをいくつか作製し、それぞれのクロストーク量を上記条件で測定した結果を図3に示す。Gse/Gscが小さいほどクロストーク量は減少し、Gse/Gscが1～0.6のとき、従来ヘッド（Gse/Gsc=1.3）に比べて、クロストーク量が6.5～8dB減少した。本実施例では、絶縁膜の薄膜化の限界から、Gse/Gscを0.6以下とすることは困難であった。

【0019】さらに、本実施例のヘッドでは、記録ヘッドからの磁界がMRヘッドに印加された後も再生出力が低下することなく、従来ヘッドより、出力が安定に動作することが確認できた。

【0020】（実施例2）図4に、本発明による別の実施例として、巨大磁気抵抗効果型ヘッドに適用した磁気ヘッドの断面図を示す。このヘッドの作製に当たっては、基板5上に、下部シールド膜（NiFe膜）10、磁気ギャップ形成用絶縁膜（AlO膜）20を実施例1と同様に形成し、巨大磁気抵抗効果膜100として、NiFe/Co、Cu、CoFe、FeMnを順次積層し

たものを用いた。次に、有機レジスト膜を積層した後、
 所望の形状にパターンニングを行い、さらに、永久磁石膜

(CoCrPt膜) 60を積層して、所望の形状に
 加工した後、Nb/Au/Nbを積層、加工し電極 7
 0とした。また、磁気ギャップ形成用絶縁膜(AIO
 膜) 80は、実施例1と同様の段差がつくように形成し
 た。さらにその上に厚さ2 μ mの上部シールド膜(Ni
 Fe膜) 90を積層し所望の形状に加工して磁気ヘッド
 とした。

【0021】本実施例におけるGMRヘッドにおいて
 も、電極部位置における磁気シールド膜の間隔Gseが、
 感磁部位置における磁気シールド膜の間隔Gscより狭
 く、Gse/Gscは0.6である。

【0022】本発明によるGMRヘッドは、Gse/Gsc
 が1.3の従来のGMRヘッドに比べて、トラック幅方
 向の感度分布における裾ひろがり少なく、実施例1で
 示した測定によるクロストーク量は約10dB減少し
 た。

【0023】さらに、本発明のGMRヘッドに記録ヘッ
 ドからの磁界がMRヘッドに印加された後も、再生出力
 が低下することなく、従来ヘッドより、出力が安定に動
 作することが確認できた。

【0024】(実施例3) 本発明の磁気抵抗効果素子を
 再生用ヘッドに用い、従来公知の誘導型薄膜ヘッドを記
 録用ヘッドとして用いる記録再生分離型磁気ヘッドを作
 製した。図5に、本実施例による記録再生分離型ヘッド
 の一部分を切断した斜視図を示す。AIO・TiCを主
 成分とする焼結体をスライダ用の基板5とした。前記実
 施例1に示した方法により段差を設けた下部シールド膜
 10および、磁気ギャップ形成用絶縁膜(AIO膜)を
 作製した。その上に、軟磁性膜(NiFeNb膜) 3
 0、非磁性導電膜(Ta膜) 40、磁気抵抗効果膜(NiFe膜)
 50、有機レジスト膜を積層した後、所望の
 形状にパターンニングを行った。さらに、永久磁石膜(CoCrPt膜)
 を積層し所望の形状に加工した後、Nb/Au/Nb 70を積層、
 加工して電極とした。さらに
 その上に、前記実施例1と同様の段差を設けた磁気ギャ
 ップ形成膜(AIO膜)、磁気シールド膜(NiFe
 膜) 90を形成した。以上の部分が再生ヘッドとして働
 く。

【0025】次に、磁気記録用ヘッドとして、厚さ3 μ
 mのAIOからなる絶縁膜を形成した後、下部磁極11
 0、上部磁極120およびコイル130からなる誘導型
 薄膜ヘッドを形成した。下部磁極110、上部磁極120
 には、スパッタリング法で形成した膜厚3.0 μ mの
 Ni-20at%Fe合金を用いた。下部磁極110およ
 び上部磁極120の間のギャップには、スパッタリン
 グ法で形成した膜厚0.2 μ mのAIOを用いた。コイ
 ル130には、膜厚3.0 μ mのCuを使用した。下部
 磁極110と上部磁極120は磁氣的に結合して磁気回

路を構成し、コイル130はその磁気回路に鎖交してい
 る。

【0026】本発明による記録再生分離型磁気ヘッドも
 従来のヘッドに比べて、トラック幅方向の感度分布にお
 ける裾ひろがり少なく、実施例1で示した測定による
 クロストーク量は約8dB減少した。

【0027】(実施例4) 前記実施例3で述べた本発明
 による磁気ヘッドを用い、磁気ディスク装置を作製し
 た。図6に磁気ディスク装置の構造の概略を示す。

【0028】磁気記録媒体140には、残留磁束密度
 0.75TのCo-Ni-Pt-Ta系合金からなる材
 料を用いた。磁気記録媒体140は駆動部150によっ
 て回転駆動される。磁気ヘッド160の記録ヘッドのト
 ラック幅は2 μ m、再生ヘッドのトラック幅は1.5 μ
 mとした。磁気ヘッド160は、駆動部170によっ
 て回転駆動されて磁気記録媒体140上のトラックを選
 択できる。磁気ヘッド160による記録再生信号は記録再
 生信号処理系180で処理される。

【0029】磁気ヘッド160に用いた磁気抵抗効果ヘッ
 ドは、従来の構造の磁気抵抗効果ヘッドより、隣接ト
 ラックからのクロストークが小さく、出力も安定なた
 め、さらにトラック幅が狭く、記録密度の高い磁気ディ
 スク装置を作製することもできる。

【0030】

【発明の効果】本発明によると、磁気抵抗効果型再生ヘ
 ッドにおける感磁部のトラック幅両端部に印加される磁
 界が減少するため、トラック幅方向の再生感度のにじみ
 を低減でき、隣接トラックからのクロストークを低減で
 きる。さらに、安定な再生出力を有する磁気抵抗効果型
 再生ヘッドを得ることができる。

【図面の簡単な説明】

【図1】本発明による磁気抵抗効果型ヘッドの断面図。

【図2】本発明によるヘッドと従来ヘッドにおけるトラ
 ック幅方向の感度分布を示す図。

【図3】電極部位置におけるシールド間隔Gseと感磁部
 位置におけるシールド間隔Gscの比Gse/Gscと、クロ
 ストラック量の関係を示す図。

【図4】本発明による巨大磁気抵抗効果型ヘッドの断面
 図。

【図5】本発明の磁気抵抗効果型ヘッドを用いた記録再生
 分離型磁気ヘッドの構造を示す斜視図。

【図6】本発明による記録再生装置の概略。

【図7】従来の磁気抵抗効果型ヘッドの断面図。

【符号の説明】

5…基板、10…下部シールド膜、20…下部磁気ギャ
 ップ形成用絶縁膜、30…軟磁性膜、40…非磁性導電
 膜、50…磁気抵抗効果膜、60…永久磁石膜、70…
 電極、80…上部磁気ギャップ形成用絶縁膜、90…上
 部シールド膜、100…巨大磁気抵抗効果膜、110…
 記録ヘッド用下部磁極、120…記録ヘッド用上部磁

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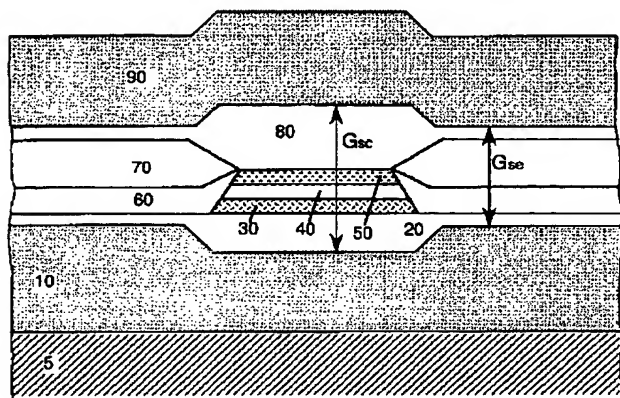
極、130…コイル、140…磁気記録媒体、150…
磁気記録媒体駆動部、160…磁気ヘッド、170…磁

8

気ヘッド駆動部、180…記録再生信号処理系。

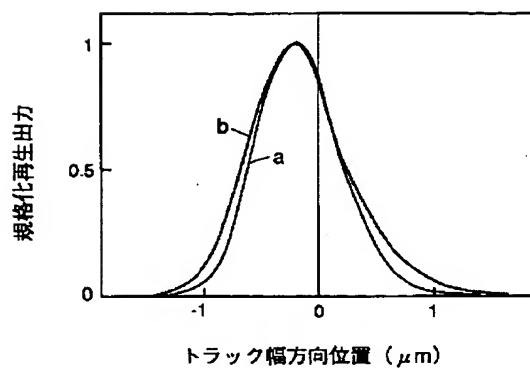
【図1】

図1



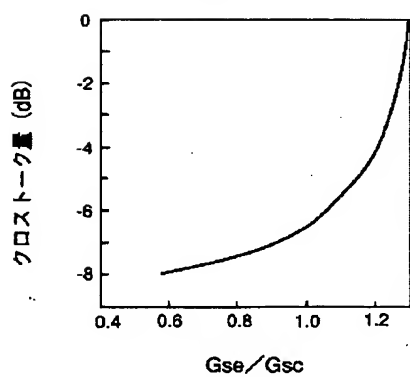
【図2】

図2



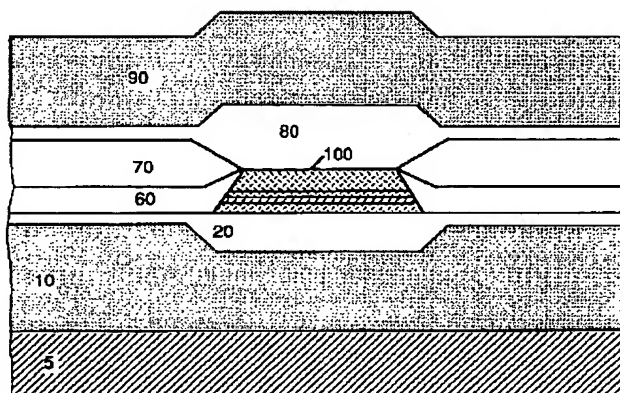
【図3】

図3



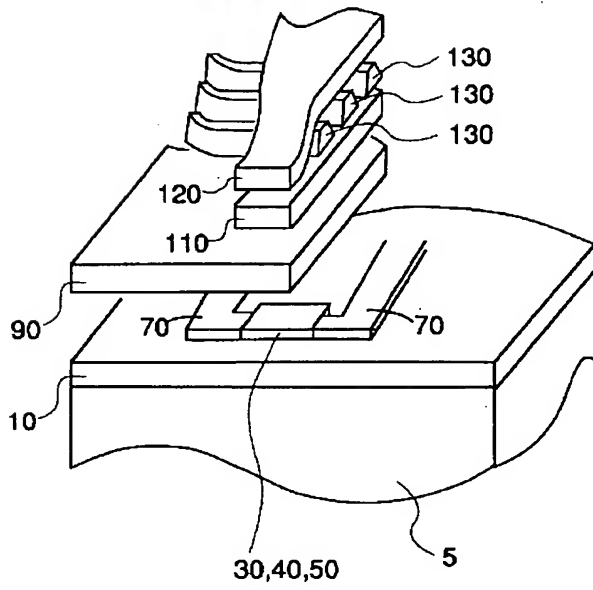
【図4】

図4



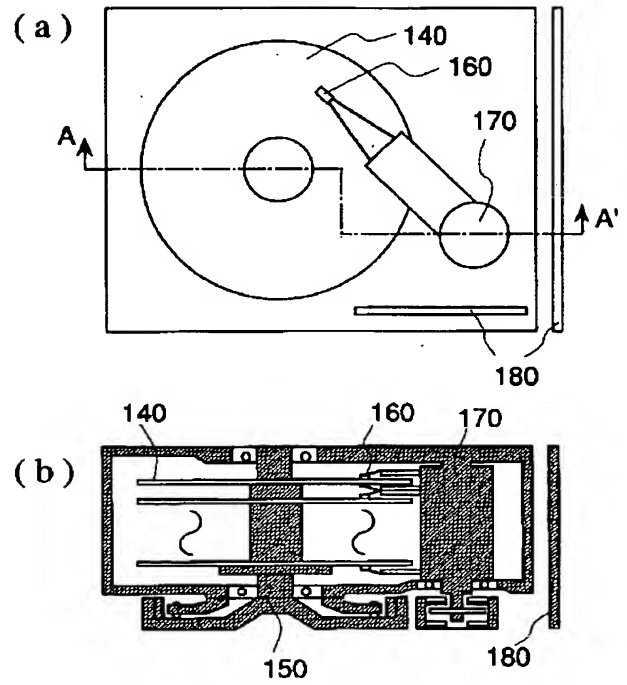
【図 5】

図 5



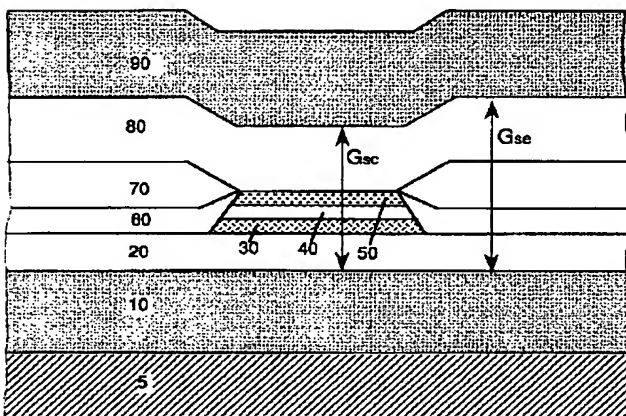
【図 6】

図 6



【図 7】

図 7



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the magnetic recorder and reproducing device which used it for the magnetoresistance-effect type reproducing-head row which started the reproducing head for reading an information signal in a magnetic-recording medium, especially was improved.

[0002]

[Description of the Prior Art] The magnetic head for reproduction is asked for high sensitivity in connection with the densification of magnetic recording. As the reproduction magnetic head of high sensitivity, what is called magnetoresistance-effect type head (MR head) is known. A magnetoresistance-effect type head detects the magnetic field from a record medium as resistance change of an element. For the conventional general magnetoresistance-effect type head, resistance is $\cos^2\theta$ as a function of the angle θ between magnetization and the direction of current. It operates based on the anisotropy magnetoresistance effect (AMR) of having the component which changes proportionally.

[0003] Physical as a magnetoresistance-effect type head which operates by the principle different from the anisotropy magnetoresistance effect on the other hand A two-layer magnetic layer is divided into Review (Physical Review) B, the 43rd volume, and 1297-1300 pages "the huge magnetoresistance effect in a soft-magnetism multilayer" by the non-magnetic layer like a publication, and the head of the structure of impressing the exchange bias magnetic field from an antiferromagnetism layer to one magnetic layer is known. Setting to such a multilayer, Resistance R is $\cos\theta$ as a function to the angle θ between magnetization of a two-layer magnetic layer. Having the component which changes proportionally is shown in the above-mentioned paper, and it is calling such an effect huge magnetoresistance effect (GMR). It is known that the magnetoresistance-effect type head using such the huge magnetoresistance effect of a multilayer shows large magnetic-reluctance variation ΔR compared with the head using the anisotropy magnetoresistance effect.

[0004] Generally, in the AMR head and a GMR head, the structure which has arranged the shield film which consists of soft magnetic materials of high permeability before and after a magnetoresistance-effect film to the medium run direction is taken. This is for leading efficiently the signal magnetic field which flows into a magnetoresistance-effect film even to the edge of a magnetoresistance-effect film, and making a magnetoresistance-effect film magnetize uniformly. Moreover, the leakage magnetic field from the adjoining bit is intercepted simultaneously. It is known that it is effective as a method of such structure raising track recording density and heightening a reproduction output.

[0005] The cross section of the conventional MR head is shown in drawing 7. In the conventional MR head, the magnetic-shielding layer 10 and the magnetic-gap layer 20 which have uniform thickness are formed on a substrate 5, and an electrode layer 70 and a permanent magnet 60 with larger thickness than a magnetoresistance-effect film are arranged to the magnetoresistance-effect film (30, 40, 50) by which patterning was carried out on it, and its both ends. Furthermore, in order to form the magnetic-shielding

film 90 through the magnetic-gap layer 80 of uniform thickness on it, the interval Gse of the magnetic-shielding film in a polar-zone position has later structure from the interval Gsc of the magnetic-shielding film in a magnetoresistance-effect film (magnetic force sensor) position.

[0006]

[Problem(s) to be Solved by the Invention] In this conventional technology, since the skirt of a sensitivity distribution of the direction of the width of recording track was long, it had set to reproduction by high track density, and there was a problem that the cross talk from an adjoining track was large. Moreover, when the strong magnetic field from a recording head was impressed to an MR head, the magnetization state of the permanent magnet film for vertical bias magnetic field impression prepared in the longitudinal direction both ends of a magnetoresistance-effect film changed, and there was a problem that the output of an MR head became unstable.

[0007] this invention operates stably and aims at moreover offering the MR head suitable for high track density.

[0008]

[Means for Solving the Problem] The above-mentioned purpose is attained by making narrower than the interval of the magnetic-shielding film in a magnetic force sensor position the interval of the magnetic-shielding film in the polar-zone position established in the longitudinal direction both ends of a magnetoresistance-effect film, or supposing that it is the same.

[0009] the ratio of the interval Gse of a magnetic-shielding film [in / the above-mentioned polar-zone position / here], and the interval Gsc of the magnetic-shielding film in a magnetic force sensor position -- Gse/Gsc -- 0.6 from -- it is desirable that it is 1

[0010] Moreover, the magnetoresistance-effect type reproducing head of this invention can constitute the record reproduction discrete-type magnetic head combining the induction-type thin film head for magnetic recording.

[0011] As for the magnetic field from a record medium and the magnetic field from a recording head which flow into the interior of a magnetic-shielding opening, the intensity becomes weaker, so that the interval of a magnetic-shielding film is narrow. As mentioned above, if the interval of the magnetic-shielding film in a polar-zone position is made narrower than before, since the magnetic field from the medium concerning the both sides of a magnetic force sensor will become weaker, bleeding of reproduction sensitivity can be reduced and the cross talk from an adjoining track can be reduced.

[0012] Furthermore, since the magnetic field impressed to the permanent magnet film prepared in the longitudinal direction both ends of a magnetic force sensor also decreases, change of the magnetization state of a medium and the permanent magnet film by the magnetic field from a recording head can be reduced, and the output stability of an MR head can be improved.

[0013]

[Embodiments of the Invention] Hereafter, the example of this invention is explained in detail.

[0014] (Example 1) The cross section of the typical magnetoresistance-effect type head by this invention is shown in drawing 1. After forming the lower shield film (NiFe film) 10 with a thickness of 2 micrometers on the substrate 5 and carrying out the laminating of the organic resist film, patterning was performed in the field which is mostly equivalent to the width of recording track so that the level difference of about 65nm might stick. Next, the insulator layer 20 for magnetic-gap formation (AlO film) was formed, and it was processed so that thickness [in / 85nm and the other field / in the thickness in the field equivalent to the width of recording track] might be set to 20nm. Furthermore, the laminating of the soft-magnetism film (NiFeNb film) 30 with a thickness of 20nm, the nonmagnetic electric conduction film (Ta film) 40 with a thickness of 10nm, and the magnetoresistance-effect film (NiFe film) 50 with a thickness of 20nm was carried out.

[0015] Next, after carrying out the laminating of the organic resist film, patterning was carried out to the desired configuration. furthermore, Nb/Au/Nb after carrying out the laminating of the permanent magnet film (CoCrPt film) 60 with a thickness of 30nm and processing it into a desired configuration -- a laminating -- it was processed and considered as the electrode 70. Furthermore, after carrying out the laminating of the insulator layer 80 for magnetic-gap formation with a thickness of 115nm (AlO film),

the insulator layer 80 equivalent to the both-sides portion of the width of recording track was removed so that the level difference of about 35nm might stick in the field equivalent to the width of recording track. Furthermore, the laminating of the up shield film (NiFe film) 90 with a thickness of 2 micrometers was carried out on it, and the desired configuration was processed and it considered as the magnetic head.

[0016] For the MR head in this example, the interval Gse of the magnetic-shielding film in a polar-zone position is 0.1 micrometers from the interval Gsc of the magnetic-shielding film in a magnetic force sensor position. It is narrow and Gse/Gsc is the structure of 0.6.

[0017] Drawing 2 shows the sensitivity distribution of a head (b) in the direction of the width of recording track conventionally [80nm latus] from the interval of the head (a) of this example, and a magnetic-shielding film [in / a magnetic force sensor position / in the interval of the magnetic-shielding film in a polar-zone position]. The reproduction output was measured moving the medium recorded on the field narrower than the width of recording track of a head in the direction of the width of recording track. As shown in drawing, the head (a) of this invention was able to reduce a spread of the skirt in a sensitivity distribution compared with the head (b) conventionally. A head is actually the edge of the next medium, and 0.3 micrometers. As a result of reproducing at the time of the overlapping off-track, the amount of cross talks of a head (a) decreased by about 8dB from (b).

[0018] Some ratios of the interval Gse of the magnetic-shielding film in a polar-zone position and the interval Gsc of the magnetic-shielding film in a magnetic force sensor position and MR heads from which Gse/Gsc differs are produced, and the result which measured each amount of cross talks on the above-mentioned conditions is shown in drawing 3 . The amount of cross talks decreases, so that Gse/Gsc is small, and Gse/Gsc is 1-0.6. It solved and the amount of cross talks decreased by 6.5-8dB compared with the head (Gse/Gsc=1.3) conventionally. At this example, it is the limitation of thin-film-izing of an insulator layer to Gse/Gsc 0.6 It was difficult to consider as the following.

[0019] Furthermore, with the head of this example, it has checked conventionally that an output operated stably from the head, without a reproduction output declining, after the magnetic field from a recording head was impressed to the MR head.

[0020] (Example 2) The cross section of the magnetic head applied to the huge magnetoresistance-effect type head is shown in drawing 4 as another example by this invention. In production of this head, the lower shield film (NiFe film) 10 and the insulator layer 20 for magnetic-gap formation (AlO film) were formed like the example 1 on the substrate 5, and what carried out the laminating of NiFe/Co, Cu, CoFe, and the FeMn one by one was used as a huge magnetoresistance-effect film 100. next, the configuration of the request after carrying out the laminating of the organic resist film -- patterning -- carrying out -- further -- permanent magnet film (CoCrPt film) Nb/Au/after carrying out the laminating of 60 and processing a desired configuration Nb -- a laminating -- it was processed and considered as the electrode 70 Moreover, the insulator layer 80 for magnetic-gap formation (AlO film) was formed so that the same level difference as an example 1 might stick. Furthermore, the laminating of the up shield film (NiFe film) 90 with a thickness of 2 micrometers was carried out on it, and the desired configuration was processed and it considered as the magnetic head.

[0021] Also in the GMR head in this example, the interval Gse of the magnetic-shielding film in a polar-zone position is narrower than the interval Gsc of the magnetic-shielding film in a magnetic force sensor position, and Gse/Gsc is 0.6.

[0022] For the GMR head by this invention, Gse/Gsc is 1.3. Compared with the conventional GMR head, there was few skirt spread in the sensitivity distribution of the direction of the width of recording track, and the amount of cross talks by the measurement shown in the example 1 decreased by about 10dB.

[0023] Furthermore, it has checked conventionally that an output operated stably from the head, without a reproduction output declining, after the magnetic field from a recording head was impressed to the MR head at the GMR head of this invention.

[0024] (Example 3) The magnetoresistance-effect element of this invention was used for the head for reproduction, and the record reproduction discrete-type magnetic head using a well-known induction-

type thin film head as a head for record was produced conventionally. The perspective diagram which cut a part of record reproduction discrete-type head by this example to drawing 5 is shown. The sintered compact which makes AlO-TiC a principal component was used as the substrate 5 for sliders. The lower shield film 10 which prepared the level difference by the method shown in the aforementioned example 1, and the insulator layer for magnetic-gap formation (AlO film) were produced. After carrying out the laminating of the soft-magnetism film (NiFeNb film) 30, the nonmagnetic electric conduction film (Ta film) 40, the magnetoresistance-effect film (NiFe film) 50, and the organic resist film moreover, patterning was carried out to the desired configuration. furthermore, Nb/Au/Nb70 after carrying out the laminating of the permanent magnet film (CoCrPt film) and processing it into a desired configuration -- a laminating -- it was processed and considered as the electrode Furthermore on it, the magnetic-gap formation film (AlO film) and the magnetic-shielding film (NiFe film) 90 which prepared the same level difference as the aforementioned example 1 were formed. The above portion works as the reproducing head.

[0025] Next, after forming the insulator layer which consists of AlO with a thickness of 3 micrometers as a head for magnetic recording, the induction-type thin film head which consists of the lower magnetic pole 110, an up magnetic pole 120, and a coil 130 was formed. 3.0 micrometers of thickness formed in the lower magnetic pole 110 and the up magnetic pole 120 by the sputtering method The nickel-20at% Fe alloy was used. AlO of 0.2 micrometers of thickness formed by the sputtering method was used for the gap between the lower magnetic pole 110 and the up magnetic pole 120. Cu of 3.0 micrometers of thickness was used for the coil 130. It joined together magnetically, and the lower magnetic pole 110 and the up magnetic pole 120 constituted the magnetic circuit, and have interlinked the coil 130 to the magnetic circuit.

[0026] The record reproduction discrete-type magnetic head by this invention also had few skirt spread in the sensitivity distribution of the direction of the width of recording track compared with the conventional head, and the amount of cross talks by the measurement which showed in the example 1 decreased by about 8dB.

[0027] (Example 4) The magnetic disk unit was produced using the magnetic head by this invention stated in the aforementioned example 3. The outline of the structure of a magnetic disk unit is shown in drawing 6.

[0028] In the magnetic-recording medium 140, it is residual magnetic flux density 0.75T. The material which consists of a Co-nickel-Pt-Ta system alloy was used. The rotation drive of the magnetic-recording medium 140 is carried out by the mechanical component 150. For the width of recording track of the recording head of the magnetic head 160, the width of recording track of 2 micrometers and the reproducing head is 1.5 micrometers. It carried out. A rotation drive is carried out by the mechanical component 170, and the magnetic head 160 can choose the truck on the magnetic-recording medium 140 by it. The record regenerative signal by the magnetic head 160 is processed by the record regenerative-signal processor 180.

[0029] The cross talk from an adjoining truck is smaller than the magnetoresistance-effect head of the structure of the former [head / magnetoresistance-effect / which was used for the magnetic head 160], the width of recording track of an output is narrow to eye a stable hatchet and a pan, and it can also produce the high magnetic disk unit of recording density to them.

[0030]

[Effect of the Invention] Since the magnetic field impressed to the width-of-recording-track both ends of the magnetic force sensor in the magnetoresistance-effect type reproducing head decreases according to this invention, bleeding of the reproduction sensitivity of the direction of the width of recording track can be reduced, and the cross talk from an adjoining truck can be reduced. Furthermore, the magnetoresistance-effect type reproducing head which has a stable reproduction output can be obtained.

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] The magnetoresistance-effect type reproducing head to which the interval of the magnetic-shielding film in the aforementioned electrode section position is narrower than the interval of the magnetic-shielding film in a magnetic force sensor position, or the magnetoresistance-effect element characterized by providing the following is characterized by the same thing in the magnetoresistance-effect type head arranged between the magnetic-shielding films of the couple estranged and prepared in the direction of a laminating Magnetoresistance-effect film The electrode of the couple for passing current on the aforementioned magnetoresistance-effect film The means for impressing a horizontal bias magnetic field to the aforementioned magnetoresistance-effect film The means for impressing a vertical bias magnetic field to the aforementioned magnetoresistance-effect film

[Claim 2] It has the electrode of the couple which supplies current to the magnetoresistance-effect film and the above-mentioned magnetoresistance-effect film which consist of a non-magnetic layer which separates a two-layer magnetic layer and them at least. In the magnetoresistance-effect type head arranged between the magnetic-shielding films of the couple by which the magnetoresistance-effect element which obtains resistance change was estranged and prepared in the direction of a laminating according to the difference of the sense of magnetization of the two above-mentioned magnetic layers The magnetoresistance-effect type reproducing head which the interval of the magnetic-shielding film in the aforementioned electrode section position is narrower than the interval of the magnetic-shielding film in a magnetic force sensor position, or is characterized by the same thing.

[Claim 3] the ratio of the interval G_{se} of the magnetic-shielding film in the above-mentioned electrode section position, and the interval G_{sc} of the magnetic-shielding film in a magnetic force sensor position -- G_{se}/G_{sc} -- 0.6 from -- the claim 1 characterized by being 1, or the magnetoresistance-effect type reproducing head of 2

[Claim 4] The magnetoresistance-effect type reproducing head of the claim 1 characterized by having the electrode of the couple prepared on the soft-magnetism film for horizontal bias magnetic field impression prepared by carrying out a laminating on the substrate, the nonmagnetic electric conduction film and the magnetoresistance-effect film, the permanent magnet film of the couple for vertical bias magnetic field impression prepared in the longitudinal direction both ends of the aforementioned magnetoresistance-effect film, and the permanent magnet film of the aforementioned couple.

[Claim 5] The magnetoresistance-effect type reproducing head of the claim 2 which an antiferromagnetism film is prepared in contact with at least one layer in the magnetoresistance-effect film which consists of a non-magnetic layer which separates a two-layer magnetic layer and them at least, and the 1 direction anisotropy is impressed to magnetization of the above-mentioned magnetic layer by magnetic switched connection with this antiferromagnetism film, and is further characterized by equipping the longitudinal direction both ends of the aforementioned magnetoresistance-effect film with the permanent magnet film of the couple for vertical bias magnetic field impression.

[Claim 6] The record reproduction discrete-type magnetic head characterized by having an induction-type thin film head for magnetic recording containing the coil which interlinks the magnetic pole of a

couple, and the magnetic pole of this couple to the magnetic-circuit means and the aforementioned magnetic circuit which are combined magnetically, and the magnetoresistance-effect type reproducing head given in any 1 term of the aforementioned claims 1-5.

[Claim 7] The magnetic recorder and reproducing device characterized by including the driving means which drive relatively a magnetic-recording medium, a head given in any 1 term of claims 1-6 and the aforementioned magnetic-recording medium, and the aforementioned head, and the record regenerative-signal processing meter connected to the aforementioned head.

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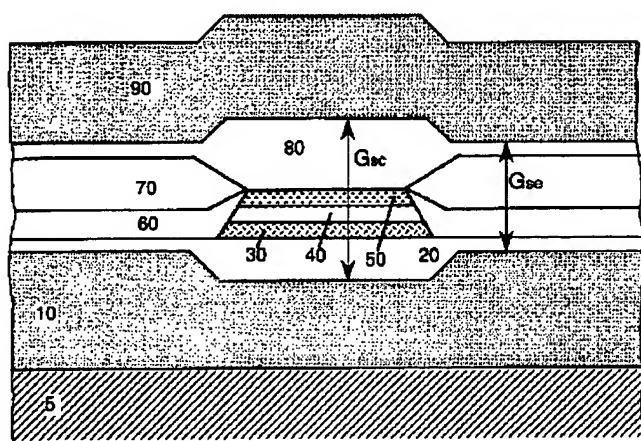
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DRAWINGS

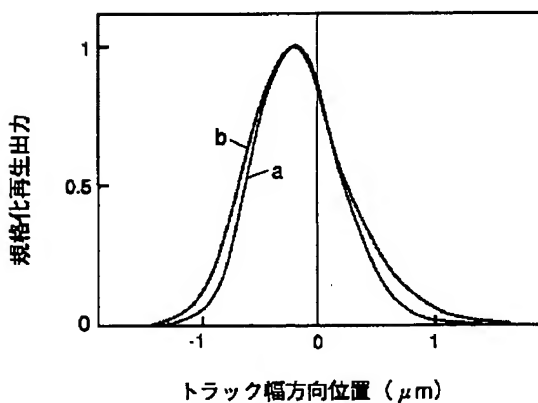
[Drawing 1]

図 1



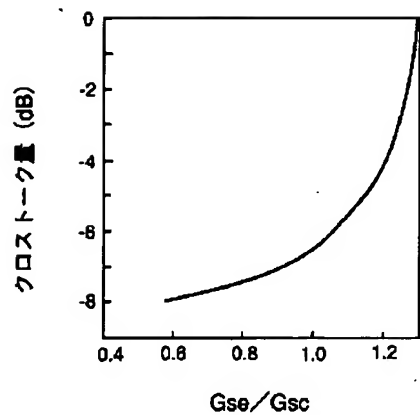
[Drawing 2]

図 2



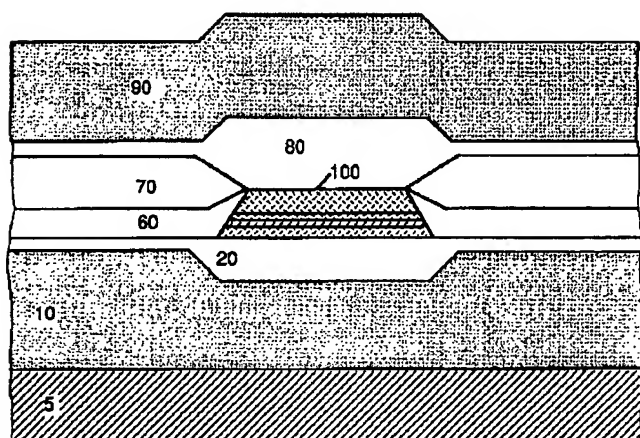
[Drawing 3]

図 3



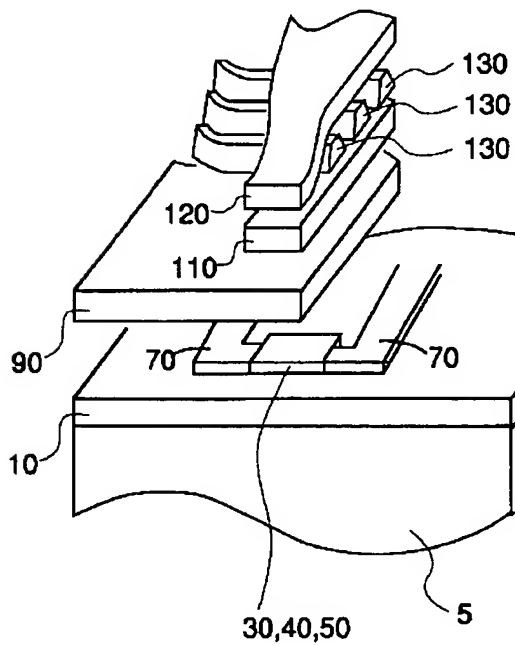
[Drawing 4]

図 4



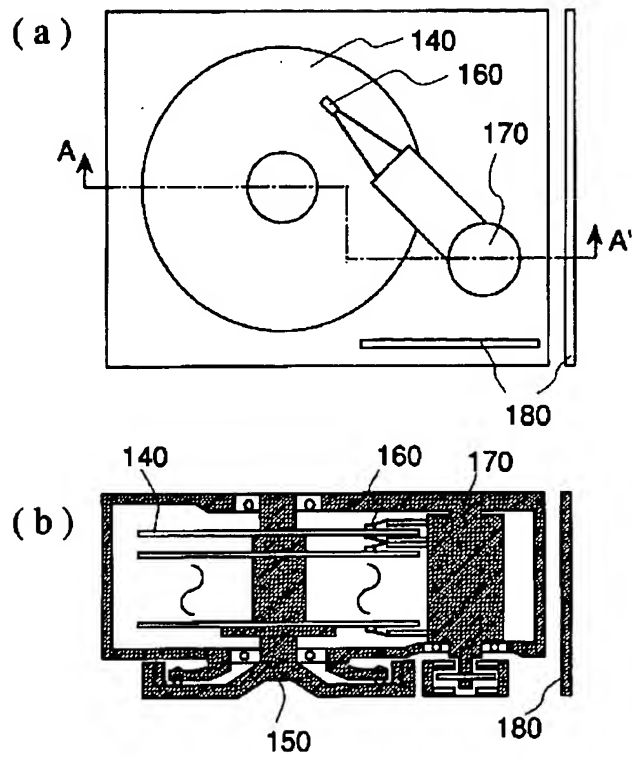
[Drawing 5]

図 5



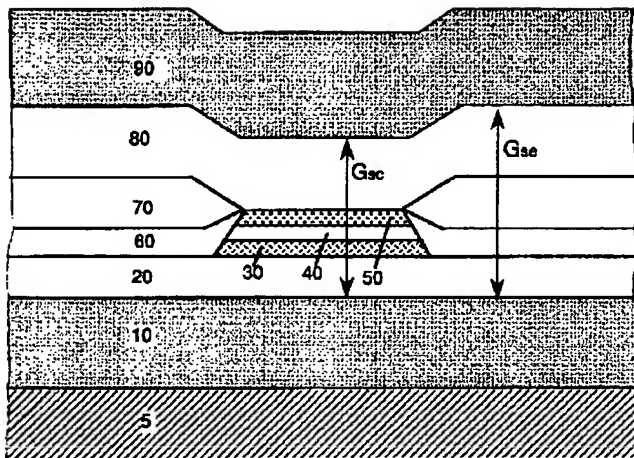
[Drawing 6]

図 6



[Drawing 7]

図 7



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